CLAIMS:

1. A method of measuring the performance of an illumination system, which comprises a radiation source and is used in an imaging apparatus, which method comprises the steps of:

- providing a test object comprising at least one Fresnel zone lens;
- arranging the test object in the object plane of the imaging apparatus;
- imaging a test object area comprising a Fresnel zone lens in an image plane by means of an illumination beam supplied by the illuminating system and by means of the imaging system of the apparatus, whereby a local effective source is imaged in the image plane
- evaluating the image of the local effective source by means of a detection device and associated processing means to determine the performance of the illumination system, characterized in that the step of providing a test object comprises providing a test object having for each Fresnel zone lens a reference mark and in that the step of imaging comprises imaging of a Fresnel zone lens area and the corresponding reference mark area within the field of view of the detection device.

2. A method as claimed in claim1, characterized in that the Fresnel zone lens area and the corresponding reference mark area are imaged as being superposed.

3. A method as claimed in claim 1 or 2, characterized in that the reference mark is an annular mark.

4. A method as claimed in claim 1, 2 or 3 characterized in that the test object is imaged out of focus over a distance equal to the focal length of the Fresnel zone lens and in that the reference mask is imaged at best focus condition.

5. A method as claimed in claim 1, 2, 3 or 4, characterized in that for imaging the Fresnel zone lens an illumination dose is used that is substantially higher than the illumination dose used for imaging the reference mark.

6. A method as claimed in claim 1, 2, 3, 4 or 5, using a test object having a number of Fresnel zone lenses and associated reference masks, characterized in that measures are taken to direct radiation from each Fresnel zone lense at a different angle through the pupil of the imaging system.

7. A method as claimed in claim 1, 2, 3, 4 or 5, characterized in that before the illumination system is measured the imaging system is illuminated by diffuse radiation and the radiation distribution in its image plane is measured to detect transmission errors of the illumination system and in that the results of the illumination system measurement are corrected for the said transmission errors.

8. A method as claimed in any one of claims 1-7, characterized in that the step of evaluating the test object image comprises the sub-steps of:

- imaging the radiation source in a resist layer and developing the resist;
- scanning the resist structure by means of a detection device having a higher resolution larger than the imaging system, and
- analyzing data supplied by the detection device in order to determine the types and amounts of different aberrations, which may be present in the source image.

9. A method as claimed in any one of claims 1-7, characterized in that the step of evaluating the test object image comprises the sub-steps of:

- forming an aerial image on a radiation-sensitive detector;
- scanning the aerial image, and
- analyzing data supplied by the image sensor in order to determine the types and amount of aberrations, which may be present in the source image.

10. A method as claimed in claim 9, characterized in that the step of forming an aerial image comprises simultaneously forming aerial images on separate detector areas.

11. A method as claimed in any one of claims 1-10, for measuring the performance of an illumination system in a lithographic projection apparatus, characterized in that:

- the step of providing a test object comprises providing a mask comprising at least one test object, and
- the step of arranging the test object in the object plane comprises arranging this mask in a mask holder of the projection apparatus.

12. A method as claimed in claim 11, characterized in that use is made of a test object, which forms part of a test mask.

13. A method as claimed in claim 11, characterized in that use is made of a test object, which forms part of a production mask.

14. A system for performing the method as claimed in claim 1, characterized in that it comprises the combination of:
- an apparatus of which the illumination system forms part;
- a test object having at least one Fresnel zone lens and an associated reference mark;
- detection means for detecting the intensity profiles of a local effective source image formed by the Fresnel lens and of the image of the reference ring;
- an image processor, coupled to the detection means, for storing and analyzing observed images and comprising analysis means for processing information about observed images to determine different kinds of aberrations the illumination system may show.

15. A system as claimed in claim 14, characterized in that the detection means comprises a resist layer for receiving a local effective source image formed by the at least one Fresnel lens and an image of the associated reference mark and a scanning detection device for scanning said images formed and developed in the resist layer.

16. A system as claimed in claim 15, characterized in that the scanning detetction device is a scanning electron microscope.

17. A system as claimed in claim 14, characterized in that the detection means comprises a radiation-sensitive detector for receiving a source aerial image formed by the Fresnel zone lens and an aerial image of the reference mark.

18. A system as claimed in claim 17, characterized in that the detector is a scanning point detector.

19. A system as claimed in claim 17, characterized in that the test object comprises a number of Fresnel zone lenses and associated reference marks, in that the detector is a scanning composed detector comprising a radiation-sensitive member and a number of transparent point-like areas, corresponding to the number of Fresnel zone lenses in the test object.

20. A system as claimed in claim 19, characterized in that the radiation sensitive member is a single element covering all transparent areas.

21. A system as claimed in claim 19, characterized in that the radiation sensitive member is composed of a number of sub-members, which number corresponds to the number of transparent areas.

22. A system as claimed in claim 21, characterized in that the position of the transparent area relative to the center of the corresponding sub-members is different for the various transparent area/sub-member pairs.

23. A measuring device for use with the method as claimed in claim 1, characterized in that it has the shape and dimensions of a production substrate and comprises electronic signal processing means, power supply means, interface means and at least one detector for detecting intensity profiles of a source aerial image formed by a Fresnel lens and an aerial image of an associated reference mark.

24. A measuring device as claimed in claim 23, characterized in that the detector is a scanning point detector.

25. A measuring device as claimed in claim 23, characterized in that the detector is a composed detector comprising a radiation-sensitive member and a number of transparent point-like areas.

26. A measuring device as claimed in claim 25, characterized in that the radiation-sensitive member is a single element covering all transparent areas.

27. A measuring device as claimed in claim 25, characterized in that the radiation sensitive member is composed of a number of sub-members corresponding to the number of transparent areas.

28. A measuring device as claimed in claim 25, characterized in that the position of a transparent area relative to the center of the corresponding sub-member is different for the various transparent area/ sub-member pairs.

29. A test object for use with the method as claimed in claim 1, characterized in that it comprises at least one Fresnel zone lens and an associated reference mark.

30. A test object as claimed in claim 29, characterized in that the reference mark is an annular mark.

31. A test object as claimed in claim 29 or 30, characterized in that it is implemented as a test mask.

32. A test object as claimed in claim 29 or 30, characterized in that it forms part of a production mask.

33. A test object as claimed in claim 29, 30, 31 or 32, characterized in that it has an amplitude structure.

34. A test object as claimed in claim 29, 30, 31or 32, characterized in that it has a phase structure.

35. A test object as claimed in any one of claims 29-34, characterized in that it is a transmission object.

36. A test object as claimed in any one of claims 29-34, characterized in that it is a reflective object.

37. A process of manufacturing devices comprising device features in at least one substrate layer of device substrates, which process comprises at least one set of the following successive steps:

- providing a production mask pattern comprising features corresponding to device features to be configured in said layer;
- illuminating by means of a controlled illumination system the production mask pattern;
- imaging, by means of a projection system, the production mask pattern in a resist layer coated on the substrate and developing this layer, thereby forming a patterned coating corresponding to the production mask pattern;
- removing material from, or adding material to, areas of the substrate layer, which areas are delineated by the pattern of the patterned coating, said controlling of the illumination system comprising detection of aberrations of the illumination system and re-setting this system based on the result of the detection, characterized in that the detection is performed by means of the method as claimed in any of claims 1-13.

38. A lithographic projection apparatus for imaging a production mask pattern, present in a mask, on a substrate, which apparatus comprises a controlled illumination system for supplying a projection beam, a mask holder for accommodating a mask, a substrate holder for accommodating a substrate and a projection system arranged between the mask holder and the substrate holder, said controlling of the illumination system comprising detection of aberrations of the illumination system and re-setting this system based on the result of the detection, characterized in that the detection is performed by means of the method as claimed in any of claims 1-13.

39. A device manufactured by means of the process as claimed in claim 37 and/or the apparatus as claimed in claim 38.